

# Electric Vehicles: Supporting Renewable Integration as a Grid Resource

California Energy Commission  
IEPR Committee Workshop  
Energy Storage for Renewable Integration

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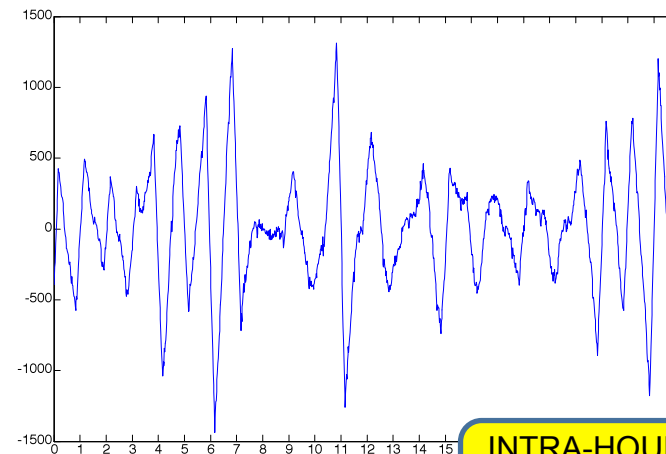
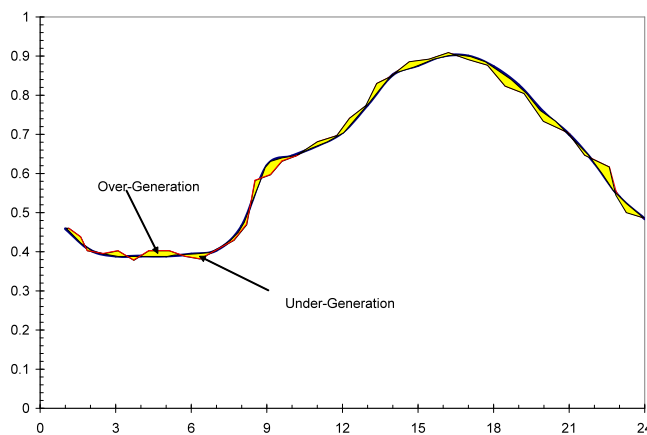
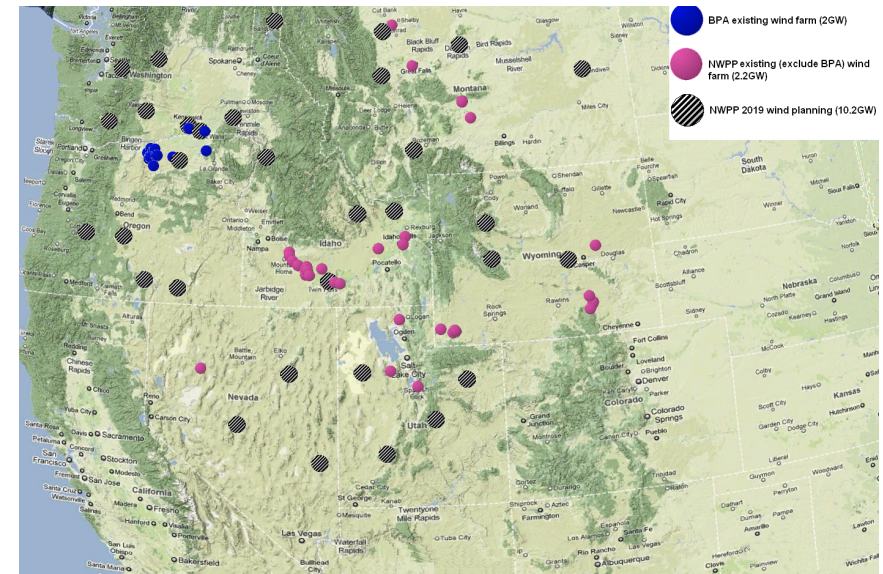
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# Case Study: Storage Opportunity in the NWPP

## What questions did we address?

- What are the likely balancing requirements for the NWPP in a 14.4 GW wind scenario for 2020 (35% wind capacity compared to total installed, about 12% based on generation)
- Relative cost competitiveness of different energy storage compared with DR and GT
- Optimal batteries sizes (right-sizing) and hybridizing
- What are the energy arbitrage opportunities?
- How much does location of storage matter?

Locations of existing and presumed capacity expansion of wind



Source: **Energy Storage for Power Systems Applications: A Regional Assessment for the Northwest Power Pool (NWPP).** PNNL-19300. April 2010

### INTRA-HOUR requirements:

- 1.85 GW increment
- -1.85 GW decrement

# Assessment: Benefits of PHEVs for Integrating Renewable Energy Resources

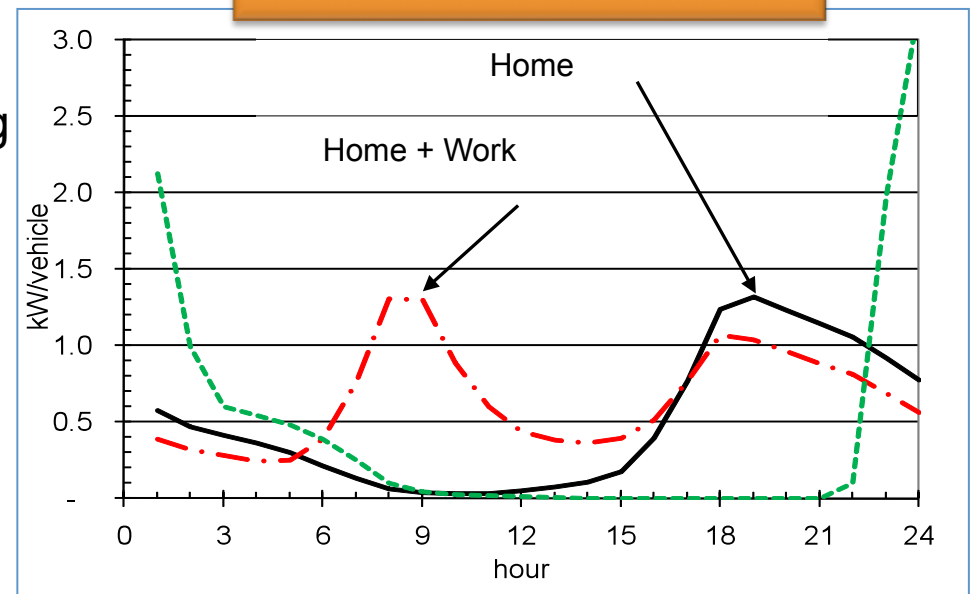
## ► Question to answer:

- How many electric vehicles are necessary to meet new balancing requirements for integrating wind generation?

## ► Assumptions

- Basic assumptions from PNNL report on storage integration into NWPP<sup>(1)</sup>
- Balancing requirements for wind capacity to increase from 4.2 to 14.4 GW (RPS of 12%)
- Requires 1.8 GW up and 1.8 GW down for intra-hour balancing
- NHTS 2001 travel patterns<sup>(2)</sup>

Charging profiles



Number of vehicles performing V2G half to meet new balancing requirements<sup>(3)</sup>

	BEV (110 miles range)	
	240V (50%) 120V (50%)	
	charging	
	home	home+work
No of Vehicles	xx mill	yy mill
% of today's vehicle stock	> 100%	<100%

<sup>(1)</sup>: Source: PNNL-19300. Energy Storage for Power Systems Applications: A Regional Assessment for the Northwest Power Pool (NWPP)

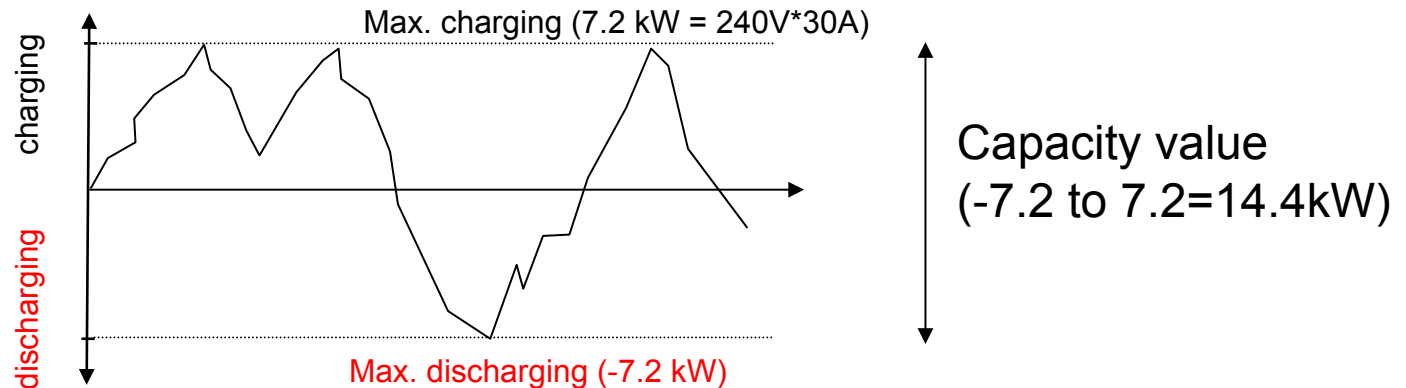
<sup>(2)</sup>: Source: Department of Transportation: 2001. National Household Travel Survey

<sup>(3)</sup>: Report expected to be published in July, 2011

# Assessment: Load can provide balancing/regulation services (V2G half) – Definition and value

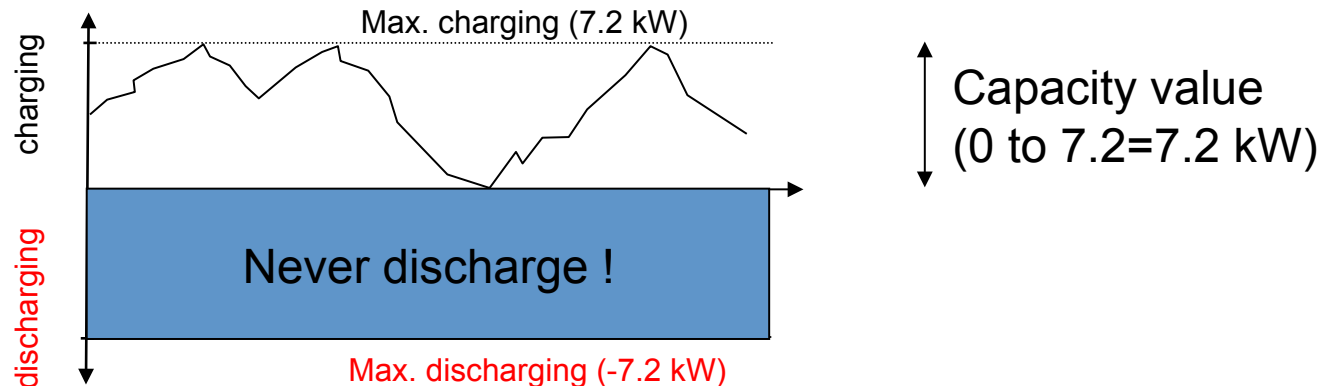
## V2G

- provides regulation service as a load and generator
- requires charging and discharging according to grid operators signal



## V2G half

- provides regulation service as a load only
- requires only charging
- modulates charging



## Attribute of “V2G half”:

- provides regulation service with  $\frac{1}{2}$  the capacity value of V2G
- however, less than half the cost because
  - no interconnection gear with grid necessary because no electricity goes back into grid
  - removes any uncertainties regarding battery life reduction because of extra cycling



# Demonstrate Grid Friendly™ Charging Technologies



- ▶ Question to answer:
  - What are the implementation issues of grid friendly charging strategies
- ▶ Implementation
  - Grid Friendly Charger Controller
    - PNNL Test Vehicle
    - Coulomb Charging Station
- ▶ Scope
  - Demonstrate Grid Friendly Charging
    - Strategies
      - ◆ Regulation services (V2G half)
      - ◆ Price-based
    - Communications
      - ◆ Utilize emerging SAE standards
  - Collaborate with ANL and NREL
  - Collaborate with ARRA Projects

